

**ORAL ARGUMENT NOT YET SCHEDULED****No. 15-1489**

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**IN THE UNITED STATES COURT OF APPEALS  
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

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SIERRA CLUB,

*Petitioner,*

v.

UNITED STATES DEPARTMENT OF ENERGY,

*Respondent,*

AMERICAN PETROLEUM INSTITUTE, LLC, ET AL.,

*Intervenors for Respondent.*

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On Petition for Review of Orders of the Department of Energy  
3357-B (November 14, 2014) and 3357-C (December 4, 2015)

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**FINAL REPLY BRIEF OF PETITIONER SIERRA CLUB**

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## GLOSSARY OF ABBREVIATIONS

Pursuant to Circuit Rule 28(a)(3), the following is a glossary of acronyms and abbreviations used in this brief, and in the cited portions of the Joint Appendix:

Addendum	Addendum to Environmental Review Documents Concerning Exports of Natural Gas from the United States
Annual Energy Outlook 2014	Energy Information Admin., Annual Energy Outlook 2014 (April 2014)
Application	Freeport LNG Expansion, LP, <i>et al.</i> , Application for Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Countries, Dk. 11-161-LNG (Dec. 19, 2011)
Authorization Order	U.S. Department of Energy, Order 3357-B, Dkt. 11-161-LNG, <i>Final Opinion and Order Granting Long-Term Multi-Contractual Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations</i> (Nov. 14, 2014)
bcf/d	Billion Cubic Feet Per Day
bcf/y	Billion Cubic Feet Per Year
Btu	British Thermal Units
Climate Action Plan	Executive Office of the President, The



	President's Climate Action Plan (June 2013)
CO <sub>2</sub> e	Carbon Dioxide Equivalent
Conditional Authorization	U.S. Department of Energy, Order 3357, Dkt. 11-161-LNG, <i>Order Conditionally Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas to Non-Free Trade Agreement Nations</i> (Nov. 15, 2013)
DEIS	Draft Environmental Impact Statement
DOE	Department of Energy
Domestic Life Cycle Report	National Energy Technology Laboratory, Life Cycle Analysis of Natural Gas Extraction and Power Generation (May 29, 2014)
EIA	Energy Information Administration
EIA Export Study	U.S. Energy Information Administration, Effect of Increased Natural Gas Exports on Domestic Energy Markets (January 2012)
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
Gas Production Totals	Energy Information Administration, Natural Gas Withdrawals and Production

(Feb. 29, 2016)

GHG	Greenhouse Gas
Global Life Cycle Report	National Energy Tech. Lab., Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States (May 29, 2014) (cited in DOE's Orders as "LCA GHG Report")
GWP	Global Warming Potential
JA	Joint Appendix
LCA GHG Report	National Energy Tech. Lab., Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States (May 29, 2014) (cited in Sierra Club's Briefs as "Global Life Cycle Report")
LNG	Liquefied Natural Gas
MJ	Mega Joule
MMBtu	Million British Thermal Units
MWh	Megawatt Hour
NEPA	National Environmental Policy Act
NERA Study	National Economic Research Associates, Macroeconomic Impacts of LNG Exports from the United States (Dec. 3, 2012)
NO <sub>x</sub>	Nitrogen Oxides
P or PP	The internal paragraph number or numbers within a FERC order.

Rehearing Request	Sierra Club, Request for Rehearing, Dk. 11-161-LNG (Dec. 15, 2014)
Rehearing Order	U.S. Department of Energy, Order 3357-C, Dkt. 11-161-LNG, <i>Opinion and Order Denying Request for Rehearing of Orders Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from Freeport LNG Terminal on Quintana Island, Texas to Non-Free Trade Agreement Nations</i> (Dec. 4, 2015)
Scf	Standard Cubic Foot
Unconventional Production Report	National Energy Tech. Lab., <i>Environmental Impacts of Unconventional Natural Gas Development and Production</i> (May 29, 2014)
Updated EIA Export Study	U.S. Energy Information Administration, Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Markets (Oct. 29, 2014)
VOC	Volatile Organic Chemicals

## **STATUTES AND REGULATIONS**

Except for those in the Addendum, pertinent statutes and regulations are contained in the Brief for the Petitioner.

## SUMMARY

This appeal challenges the Department of Energy's ("DOE") authorization of liquefied natural-gas ("LNG") exports from the Freeport, Texas, terminal. DOE acknowledges that as a result of this authorization, and DOE's past and potential future authorization of similar proposals, it is reasonably foreseeable that cumulative U.S. LNG exports will amount to 3,500 billion cubic feet per year ("bcf/y") in coming years, DOE Br. at 40, more than 16% of annual onshore gas production. Annual Energy Outlook 2014 at D-15, JA0523.

Abundant record evidence establishes—without meaningful contradiction—that the consequences of such exports would be an increase in domestic gas prices, a significant increase in U.S. natural-gas production, and a shift in the U.S. electric sector from gas to coal. Energy Information Administration ("EIA") Export Study, JA0124. DOE violated both the National Environmental Policy Act ("NEPA") and the Natural Gas Act by failing to take a hard look at these "upstream" impacts or to explain how DOE's conclusion that exports would have "little more than a modest, incremental impact on the environmental issues" surrounding natural-gas production comports

with this evidence. Authorization Order at 87, JA1027. *See* Part I, *below*. Because cumulative exports amounting to 3,500 bcf/y were foreseeable, DOE was required to address the increased gas production and coal use that would result from this level of exports. Instead of taking that hard look at foreseeable effects, DOE dismissed analysis of those impacts as “speculative” because ultimate export levels were “fundamentally uncertain.” Part I.A-B.

In its brief, DOE argues that it satisfied NEPA by providing a “qualitative” analysis of these impacts (a rationale that departs from that offered in its decision documents). Part I.B.1. Uncontroverted record evidence demonstrates, however, that DOE could provide reasonable predictions regarding these impacts far beyond DOE’s mere acknowledgement that exports “might” contribute to some significant impacts somewhere. Part I.B.2. DOE offers no facts or evidence indicating that the cost of providing such predictions would have been “exorbitant,” and DOE provides nothing to support its assertion that doing so would be “burdensome.” Part I.B.3. NEPA’s “rule of reason” does not condone DOE’s decision to provide only an equivocal acknowledgement of these impacts (which the Agency seeks to re-

characterize as a ‘qualitative analysis,’ despite the absence of any discussion that could fairly be termed ‘analysis’). Part I.B.4.

DOE’s analysis of effects “downstream” of the export terminal—the emissions from ocean transport, regasification, and combustion of exported gas—was also arbitrary. DOE provided an incomplete and therefore misleading study by comparing life-cycle emissions of using U.S. LNG with emissions of using coal or other sources of natural-gas in overseas markets. DOE agreed that U.S. LNG exports will also compete with renewable energy, but provided no analysis or comparison regarding renewables. Part I.C.

Finally, DOE failed to reasonably complete its Natural Gas Act public interest assessment by failing to support its conclusion that the cumulative effects of exports would be modest or to provide a rational comparison of benefits and harms. Part II.

## **ARGUMENT**

### **I. NEPA**

NEPA requires agencies to take a “hard look” at the effects of proposed actions. Agencies must investigate all “reasonably foreseeable”

impacts, 40 C.F.R. §§ 1508.7, 1508.8, which are those “sufficiently likely to occur that a person of ordinary prudence would take [them] into account.” *City of Shoreacres v. Waterworth*, 420 F.3d 440, 453 (5th Cir. 2005). An Environmental Impact Statement (“EIS”) must analyze and disclose direct, indirect, and cumulative impacts, 40 C.F.R. §§ 1508.7, 1508.8, including both intended and unintended consequences of agency action. 42 U.S.C. § 4331(b)(3). Because NEPA’s goal is “to predict the environmental effects of proposed action before the action is taken and those effects [are] fully known,” this analysis necessarily involves “[r]easonable forecasting and speculation.” *Scientists’ Inst. for Pub. Info. v. Atomic Energy Comm’n*, 481 F.2d 1079, 1092 (D.C. Cir. 1973).

Ultimately, the EIS must present “information sufficient to permit a reasoned choice of alternatives so far as environmental aspects are concerned,” including the choice between acting and taking no action at all. *Nat. Res. Def. Council v. Morton*, 458 F.2d 827, 836 (D.C. Cir. 1972). This requires more than merely acknowledging that an action may have some adverse impacts: the EIS must examine and disclose the “significance” of impacts, 40 C.F.R. § 1502.16(a)-(b), providing “detailed information” sufficient to “evaluate the severity” of impacts. *Robertson*



*v. Methow Valley Citizen Council*, 490 U.S. 332, 349, 352 (1989).

“General statements about ‘possible’ effects and ‘some risk’ do not constitute a ‘hard look’ absent a justification regarding why more definitive information could not be provided.” *Neighbors of Cuddy Mountain v. U.S. Forest Serv.*, 137 F.3d 1372, 1379-80 (9th Cir. 1998).

Here, the EIS, Addendum, and Global Life Cycle Report (even if DOE could rely on them) all fall far short of NEPA’s requirements.<sup>1</sup> None of the environmental review documents acknowledge the basic fact that DOE’s authorization of exports has the potential to cause fundamental changes in the American energy landscape, including a

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<sup>1</sup> DOE justifies its reliance on the Addendum and Global Life Cycle Report by characterizing their non-compliance with NEPA as “trivial [notice] violations.” DOE Br. at 37 n.15. The problems with DOE’s reliance on these documents go beyond notice. The Addendum asserts conclusions directly at odds with the EIS. For example, the Addendum concludes that if exports occur, domestic gas production *will* increase. Addendum at 1, JA0815. The EIS concludes that it is impossible to “know ... even if” exports would increase gas production, even assuming “LNG export projects[ are] constructed and operated.” EIS Appendix L-189, JA0732.

As to DOE’s conceded public-notice violation, although courts will not reverse for harmless error, DOE cannot perpetually ignore NEPA requirements. *See* 80 Fed. Reg. 22,992 (Apr. 24, 2015), 80 Fed. Reg. 72,719 (Nov. 20, 2015) (repeating this error).

sizeable increase in domestic gas production and associated environmental harms. Instead, DOE asserts, without supporting analysis, that exports would have “little more than a modest, incremental impact on the environmental issues” surrounding natural-gas production. Authorization Order at 87, JA1027. In reaching this conclusion, DOE repeatedly branded exports’ impacts on gas production and coal use as uncertain, and DOE consistently asserted that any export-induced changes in these industries would not have “foreseeable” environmental effects. EIS at 4-240, JA0671; Addendum at 2, JA0816; Authorization Order at 84, JA1024; Rehearing Order at 16, 19, JA1115, 1118. Although DOE now argues that the Addendum illustrated “the potential scale of impacts” that would be caused by exports, DOE Br. at 41-42, the Addendum only discussed the impacts of existing gas production, without providing any discussion of the extent to which additional export-induced production would aggravate these harms. In DOE’s own words, the environmental review documents did “not attempt to identify or characterize the incremental environmental impacts that would result from LNG exports.” Authorization Order at 84, JA1024.

DOE did not just fail to “quantify” the upstream environmental impacts of exports, DOE Br. at 38; it failed to address these effects in any meaningful way. The Addendum merely acknowledges that increased gas production “may” increase ozone levels and “may” frustrate some areas’ efforts to reduce pollution to safe levels. Addendum at 27-28, JA0841-0842. It provides no analysis of those effects—no discussion of their likelihood, magnitude, or consequences for public health. The Addendum’s discussion of other effects of increased natural-gas production are even less informative.

Uncontroverted record evidence demonstrates that reasonably foreseeable exports would be likely to significantly increase U.S. gas production. The record, like common sense, indicates that such an increase would significantly impact U.S. efforts to reduce the gas sector’s emissions of methane and other pollutants, *see* Opening Br. at 35-37, yet DOE did not even acknowledge these potential conflicts. Record evidence indicates that exports will also increase U.S. coal use, and corresponding emissions, but rather than discuss the impact of exports on efforts to reduce these emissions, DOE asserted without

analysis that the Clean Power Plan would prevent exports from having this effect.

Nor did DOE take a hard look at impacts occurring “downstream” of the export terminal, resulting from transportation, regasification, and combustion of exported natural-gas. Sierra Club does not challenge DOE’s decision to structure analysis of these impacts around comparisons between the greenhouse gases emitted by foreign use of U.S. LNG and emissions from other energy sources. But once DOE decided to use such a comparison, DOE could not present an incomplete picture of the energy sources that exported LNG may displace. DOE admitted that exported gas would also compete with renewables, and the record demonstrates that renewables were prevalent in likely import markets. Authorization Order at 92-93, JA1032-1033. Yet DOE provided no analysis of the effects of potential displacement of renewables.

DOE primarily contends that it is entitled to discretion in carrying out its NEPA obligations. But discretion is not unlimited. Most importantly, DOE’s conclusions must be firmly grounded in the record; here, the record straightforwardly contradicts the agency’s assertions.

DOE has not cited a single case in which a court has upheld an agency's analysis on a record analogous to that presented here.<sup>2</sup>

A. DOE Failed to Consider the Cumulative Effects of Exports

NEPA required DOE take a hard look at the “incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.” 40 C.F.R. § 1508.7. The Addendum acknowledged EIA's estimate that exports would reach 3,500 bcf/y, and DOE now admits that this level of exports is foreseeable. DOE Br. at 40 (citing Addendum at 43, JA0857).

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<sup>2</sup> DOE discusses the facts or reasoning from only three cases. DOE attempts to distinguish two cases that overturned agency NEPA review, *Calvert Cliffs' Coordinating Committee v. U.S. Atomic Energy Commission*, 449 F.2d 1109 (D.C. Cir. 1971) and *Mid States Coalition for Progress v. Surface Transportation Board*, 345 F.3d 520 (8th Cir. 2003). The third, *Mayo Foundation v. Surface Transportation Board*, 472 F.3d 545, 548 (8th Cir. 2006) upheld (after remand from *Mid States*) agency analysis of indirect coal impacts where that EIS included modeling of how the action would foreseeably influence energy use throughout the nation and a reasoned explanation, based on the result of that modeling, of the significance of resulting impacts to regional air quality.

This acknowledgment alone, however, falls short of the cumulative impacts analysis NEPA requires; DOE provided no discussion of the *impacts* that would result from this admittedly foreseeable level of exports. Instead, DOE stated that the “incremental environmental impacts” of LNG exports “are not reasonably foreseeable” because there was “uncertainty as to the aggregate quantity of natural gas that ultimately may be exported.” Authorization Order at 84, JA1024; *see also* Rehearing Order at 17, JA1116, Addendum at 1, JA0815, DOE Br. at 41 (asserting “fundamental uncertainties” regarding foreign demand for U.S. LNG).

Reasonable foreseeability, however, does not require certainty, or even “reasonable certainty,” DOE Br. at 38, 48, a term that does not appear in the NEPA regulations or caselaw. An effect is reasonably foreseeable if it is “sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision.”

*Waterworth*, 420 F.3d at 453.

DOE, in the record, reasonably foresaw 3,500 bcf/y of exports; DOE was thus required to take (and capable of taking) a hard look at the consequences that would follow from that level of exports.

B. Upstream Effects of Induced Gas Production and Coal Use

“DOE believes” that if LNG exports occur, “export volumes would be offset by some combination of increased domestic production of natural gas (principally from unconventional sources), decreased domestic consumption of natural gas, and an adjustment to the U.S. net trade balance in natural gas with Canada and Mexico.” Addendum at 1, JA0815.

Evidence in the record uniformly predicts that out of these effects, an increase in gas production will predominate. *Id.* at 2 n.2, 5, JA0816, 0819 (summarizing EIA Export Study at 6, JA0137). While DOE’s brief states only that exports “could” or “might” increase domestic gas production, DOE Br. at 18, 30, 38, DOE provides no explanation for these qualifiers, and no theory of how exports could occur *without* causing an incremental increase in natural-gas production. Yet DOE refused to provide any analysis of the impact of such additional production.

Studies and models in the record also uniformly conclude that exports will shift existing gas consumers in the utility sector toward increased coal use. *E.g.*, EIA Export Study at 12, JA00143. DOE has

argued that these predictions of increased coal use do not account for recent regulations. Authorization Order at 88-89, JA1028-1029. Yet despite those regulations, DOE relied on the EIA Export Study's price forecasts, which concluded that exports' effect on the price and supply of natural-gas would be mitigated by electric utilities' ability to curtail their natural-gas demand. DOE confirmed that the Study was "fundamentally sound" on this point, and stated that it had "seen no developments that would disturb" the Study's conclusions. Authorization Order at 94-95, JA1034-1035. DOE cannot adopt the Study's prediction that utilities will shift from gas to coal in one part of its Order (to estimate the price impact of exports), and simultaneously reject that prediction in another (when asked to assess the environmental impacts of exports). *Scientists' Inst. for Pub. Info.*, 481 F.2d at 1097.

Nor did DOE articulate a basis for concluding that studies in the record failed to account for the Clean Power Plan and other regulations. Although EIA's Updated Export Study predated the Clean Power Plan, this study presented an "accelerated coal retirement" scenario that was specifically developed to serve "as a proxy for possible future policies to



mitigate greenhouse gas emissions” from power-plants. Annual Energy Outlook 2014 at IF35, JA0513. EIA predicted that, even in this scenario, natural-gas exports would increase coal use. Updated EIA Export Study Table B5, JA0931. DOE offers no explanation as to why the effects of the actual Clean Power Plan are likely to be meaningfully different than the effects of EIA’s proxy.

1. Indirect Upstream Effects Are Foreseeable and Within the Scope of NEPA Review

Before this Court, DOE argues that it satisfied NEPA by providing a “qualitative” analysis of the “type and nature” of environmental effects caused by export-induced gas production, and by considering the greenhouse gas impacts of export-induced coal use. DOE Br. at 38-39, 54. DOE does not defend two rationales it offered in the Authorization and Rehearing Orders for excluding these effects from NEPA review entirely. In those orders, DOE argued, first, that NEPA did not require analysis of these effects because the effects were entirely unforeseeable. Authorization Order at 84, JA1024, Rehearing Order at 16-17, JA1115-1116. Here, DOE concedes that the nature of

these effects is foreseeable, even though DOE wrongly contends that the extent is not. DOE Br. at 38.

Second, the orders argued that effects of gas production and coal use were outside “the scope of NEPA review” because the “causal relationship” between these effects and DOE’s action was not “reasonably close” or “proximate.” Rehearing Order at 14, 19, JA1113, 1118. DOE’s brief only discusses the nature of the causal relationship between exports and these effects insofar as it affects actual foreseeability. While DOE argues—wrongly—that 40 C.F.R. § 1508.8 implicitly incorporates a “proximate cause” requirement, DOE does not argue that the environmental impacts of export-induced gas production are not proximately caused by DOE’s authorization of exports. DOE Br. at 42-43 (citing *Paroline v. United States*, 134 S.Ct. 1710 (2014)).<sup>3</sup>

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<sup>3</sup> *Paroline* concerned a statute explicitly requiring proximate cause, but cited in dicta two cases that found implied proximate causation requirements in Clayton Act antitrust and RICO claims for civil damages. 134 S.Ct. at 1720 (citing *Holmes v. Sec. Inv’r Prot. Corp.*, 503 U.S. 258, 267 (1992), *Associated Gen. Contractors of California v. California State Council of Carpenters*, 459 U.S. 519, 529 (1983)). NEPA

Freeport argues that the effects of export-induced gas production and coal use are entirely outside NEPA's 'boundaries.' Freeport Br. at 26. DOE does not adopt that argument, and so cannot prevail on that basis. *New Jersey v. EPA*, 517 F.3d 574, 581 n.3 (D.C. Cir. 2008). In any event, whatever authority agencies have to set boundaries on their analysis, they cannot avoid the consequences of the central questions posed by the substantive statute at issue: here, effects of exports on gas supply and use. *NAACP v. Fed. Power Comm'n*, 425 U.S. 662, 670, (1976). Moreover, there is a feasible, bounded analysis that can answer these questions, as demonstrated by, *inter alia*, the EIA Export Study.

## 2. DOE Can Reasonably Foresee the Extent of Upstream Impacts

DOE defends its decision not to "identify or characterize" exports' impacts by arguing that any additional analysis would have been "highly speculative," and that details beyond what DOE provided could not "be reasonably foreseen." DOE Br. at 31, 38, 42. Mere assertions of

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serves a fundamentally different purpose than these statutes. Opening Br. at 53.

uncertainty are not a basis for shirking NEPA responsibilities.

*Scientists' Inst. for Pub. Info.*, 481 F.2d at 1092. Because NEPA requires “reasonable forecasting,” *id.*, an agency arguing that information regarding foreseeable effects is not available must explain what, specifically, prevents the agency from providing thorough analysis. 40 C.F.R. § 1502.22. Here, abundant evidence in the record demonstrates that DOE had tools to forecast every link in the causal chain connecting reasonably foreseeable exports to the environmental effects of export-induced gas production and coal use.

i. DOE Can Foresee the Amount and Region of Export-Induced Gas Production and Coal Use

The record contains multiple studies predicting the extent to which natural-gas production will increase in response to various levels of exports. DOE characterized the EIA Export Study as “fundamentally sound.” DOE has not identified any flaws in EIA’s underlying model or methodology, and DOE determined that EIA’s predictions were reliable enough to provide the basis for DOE’s economic analysis. Authorization Order at 95, JA1035.

Nonetheless, DOE now states that it “cannot predict, with any reasonable certainty, the extent to which LNG export authorizations

will add to increased production.” DOE Br. at 38. The only justification for this statement offered in the record is DOE’s assertion of uncertainty regarding the quantity of exports that will actually occur. Addendum at 1, JA0815; Authorization Order at 84, JA1024. As explained above, however, NEPA requires DOE to address the effects of “reasonably foreseeable” cumulative exports—which DOE admits are 3,500 bcf/y—not the effects of exports that DOE determines to be “reasonably certain” to occur. Although “DOE did not attempt to quantify the marginal additional increase in natural gas development” or coal use “that would not occur but for [3,500 bcf/y of] LNG exports,” DOE Br. at 38, nowhere in the record did DOE argue that it was unable to do so.

EIA’s “fundamentally sound” models can also predict *where*, at the level of gas ‘plays,’ increased production will occur. DOE observes that such predictions require “model[ing] price elasticity of natural-gas production in every natural-gas-producing region in the lower-48 states.” DOE Br. at 47. The record demonstrates, however, that EIA already uses precisely such a model. EIA’s National Energy Modeling System (“NEMS”) incorporates “a play-level model” to predict how

natural-gas production will “respon[d]” to changes in the market price for gas. EIA, Documentation of the Oil and Gas Supply Module, 2-1, 2-3 (2011), JA0495, 0497. EIA’s Export Study already predicted where, on a broad, regional level, export-induced production would occur. EIA, Lower 48 Natural Gas Production and Wellhead Prices by Supply Region (Jan. 2012), JA1082 (projecting how export-induced increases in gas production will be allocated among six multi-state regions). The record illustrates that EIA’s underlying tools are capable of providing more granular results, predicting increases in individual plays. *See, e.g.*, Annual Energy Outlook 2014 at MT-21, MT-25, JA0517, 0521 (predicting gas production “in the Marcellus shale play”). Private models relied upon by intervenors to tout exports’ benefits have similar capabilities.<sup>4</sup>

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<sup>4</sup> Deloitte Marketpointe, Made in America, 1-2, JA0036-0037. (“Deloitte’s forecasts are built on a “disaggregated representation[] of North America” used to “project[] production-based resource volumes and cost ... in each market area.”), ICF International, U.S. LNG Exports: Impacts on Energy Markets and the Economy, 18 (May 15, 2013), JA0281 (ICF’s model “consider[s] the interaction between supply and demand” in order to predict “[g]as production changes in various North American basins caused by shifts in natural gas prices.”).

Nothing in the record challenges these models' ability to predict play-level impacts. DOE did *not* determine that it was impossible to "forecast, with reasonable certainty, which gas-producing regions in the lower-48 states will see production increases and in what amount from assumed LNG exports." DOE Br. at 48 (citing Rehearing Order at 16-19, JA1115-1118). In the cited portion of the Rehearing Order, DOE argued that it could not predict where increased production would occur "at the wellhead or local level," but acknowledged that "the size of the shale plays makes them more reliable units for generating projections from economic models than smaller units such as counties." Rehearing Order at 16, 18, JA1115, 1117. DOE did not dispute that available tools could predict, at the play-level, how production would increase in response to a given level of exports; DOE instead argued, wrongly, that play-level modeling would not be useful. *Id.* at 18-19, JA1117-1118.

DOE did not acknowledge, however, that play-level predictions enable DOE to analyze the extent of export-induced gas production's region impacts on ozone and water, as explained *infra*. Even if DOE had simply disclosed predictions of the amount and region of production increases, this would have provided important information regarding

the scale of impacts that is otherwise absent from the EIS or Addendum. For example, if cumulatively foreseeable exports would lead to a 20% increase in natural-gas production in the Barnett Shale, disclosing this information provides important context about the extent to which the impacts described in the Addendum are likely to increase.

ii. DOE Failed to Take a Hard Look Ozone Impacts of Export-Induced Gas Production

DOE contends that it took a hard look at ozone impacts by acknowledging that: “LNG exports could ‘accelerate’ unconventional natural-gas development,” “increased natural-gas production might ‘create new or expanded ... non-attainment areas’ not meeting national ambient air quality standards for ozone,” and impacts on ozone were “potentially significant.” DOE Br. at 38 (quoting Addendum at 27, JA0841), 61. These scant acknowledgments entirely fail to “evaluate the severity” of impacts. *Robertson*, 490 U.S. at 349, 352. They do not reflect the amount of gas production that will foreseeably result from the level of exports at issue here. DOE provides no indication of whether export-induced production will be enough to cause such impacts, where these impacts might occur, or how severe they might be. Absent such details,



DOE's analysis cannot support an informed choice regarding the DOE's export authorization. *Morton*, 458 F.2d at 836.

The record demonstrates that DOE could have prepared a thorough analysis of the effects of additional gas production in individual plays. For example, DOE does not need to make unsupported “assumptions” about air pollutant emissions. DOE Br. at 46. The NETL reports—which DOE commissioned specifically to address the impacts of exports—provide detailed estimates of the amount of emissions from each stage of the well-to-terminal life cycle. Opening Br. at 67-68.

Other tools in the record enable DOE to foresee how play-level increases in emissions will affect regional ozone levels. The Addendum summarized two studies that modeled how anticipated play-level increases in gas production would affect regional ozone levels. Opening Br. at 69-70; Addendum at 28-29, JA0842-0843 (describing “CAMx” modeling). Nothing in the record calls these studies' methodology or reliability into question.

DOE's brief argues that DOE could not perform a similar analysis here because DOE “cannot forecast, with reasonable certainty, which gas-producing regions in the lower-48 states will see production

increases and in what amount.” DOE Br. at 48. But DOE identifies only two barriers to such a forecast, both surmounted in the record, as explained above: “uncertainty” regarding export levels and the need for a play-level model.

The record demonstrates that DOE could have predicted the extent to which 3,500 bcf/y of exports would increase production in individual gas plays, and how these increases would affect ozone levels throughout the country. Rather than merely acknowledging that exports might increase gas production and that this might significantly impact ozone, DOE could have disclosed the identity and number of air quality regions that would suffer increased ozone levels, the severity of these increases, and whether these increases would cause or exacerbate violations of EPA’s air quality standards. For example, DOE could have predicted what effect the increases in production in the Barnett and Haynesville shale gas plays surrounding Dallas would have on ozone levels there, the effect of increases in the Haynesville and Eagle Ford on Houston, or the effect of increases in the Marcellus on Pittsburgh. *See* Addendum at 6, JA0820 (map of shale plays).

iii. DOE Failed to Take a Hard Look at Export-Induced Impacts on Water Resources

Forecasts of play-level gas production increases also enable DOE to estimate regional impacts to water resources. The record includes estimates of the amounts of water consumed and wastewater produced, per unit of natural-gas production, broken down by type of gas production, reflecting differences between major shale plays. Domestic Life Cycle Report at 55, JA0571. DOE does not dispute that this information, combined with play-level predictions of production increases, would enable DOE to predict regional changes in water consumption and wastewater production associated with export-induced natural-gas production. DOE Br. at 49-50. Instead, DOE argues that such predictions would not provide meaningful information, because regional estimates do not enable DOE to predict impacts to “particular water bodies or resources.” *Id.* DOE’s contention that such regional assessments are uninformative rings hollow; the only discussion of the scale of water impacts that DOE *did* provide was a play-level assessment of the water consumed by existing gas production. Authorization Order at 84, JA1024; Addendum at 12, JA0826.

iv. DOE Can Foresee Air Pollution Impacts of Increased Coal Use

DOE provided no discussion or analysis of the impact of non-greenhouse gas air pollution emitted by export-induced coal consumption. Instead, DOE simply claimed that, in light of recent EPA regulations, any increase in coal production was unlikely. Authorization Order at 89-90, JA1029-1030; Rehearing Order at 23, JA1122. The record does not support this assertion, as explained above.

DOE's brief alternatively contends that the effects of export-induced coal combustion's emissions of non-greenhouse-gases are unforeseeable because DOE cannot "reasonably forecast where" such increases will occur. DOE Br. at 54; *id.* at 31. The Court should reject this post-hoc argument, which was not articulated in the record. *Cf.* Authorization Order at 88-90, JA1028-1030; Rehearing Order at 23, JA1122; *Nat'l Shooting Sports Found. v. Jones*, 716 F.3d 200, 214 (D.C. Cir. 2013). In any event, the record demonstrates that EIA's modeling tools for coal use, like natural-gas production, are built on models of individual regions. EIA, *The National Energy Modeling System: An*

Overview, 6, 45, 72 (2009), JA0484, 0488, 0490.<sup>5</sup> Other agencies have used NEMS to predict both how agency action will affect coal use in individual regions across the country and the resulting impacts on air quality. *See Mayo Found.*, 472 F.3d at 555 (explaining that NEMS “not only forecasts coal supply and demand but also quantifies environmental impacts” of coal use). DOE argues that NEMS cannot predict “local” impacts, but nothing in the record supports DOE’s contention that the “regional” predictions NEMS provides are too coarse to support analysis of ozone or other impacts.

DOE argues that Sierra Club never specifically argued that DOE “should have modeled the impacts of induced coal consumption on specific ozone nonattainment areas.” DOE Br. at 54. Until now, Sierra Club did not have cause to do so: DOE had never disputed that it had the tools to predict the impacts of increases in coal consumption, even

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<sup>5</sup> EIA’s Updated Export Study provides estimates, for various scenarios, effects on coal use in individual regions. *See* <http://www.eia.gov/oiaf/aeo/tablebrowser/> (select “Effect of Increased Natural Gas Exports on Domestic Energy Markets” from “Publication” menu, “Electric Power Projections for EMM Region” from “Table” menu, then select an individual region). *E.g.*, <https://goo.gl/oKqJKP> (estimates for Texas).

though Sierra Club consistently called for such predictions. Protest at 12, 35, JA0059, 0082; Comment on DEIS at 50, JA0462; Rehearing Request at 18, JA1075.

v. DOE Failed to Adequately Assess Upstream Greenhouse Gas Emissions

DOE did not estimate the amount of greenhouse gases that would be emitted by export-induced gas production or coal use resulting from the Freeport project or the 3,500 bcf/y of cumulative exports that DOE acknowledges are foreseeable.

DOE argues that it considered emissions from the terminal, induced gas production, and induced coal use in, respectively, the EIS, Addendum, and EIA Export Study. DOE Br. at 57. The Addendum, however, only discusses greenhouse gas emissions generally, without reference to any particular volume of exports or export-induced gas production. The EIA Export Study similarly does not address the volumes of exports that DOE argues are foreseeable here; moreover, DOE cannot rely on this study while simultaneously arguing that recent regulatory developments render the study invalid.

Thus, nothing in the record demonstrates that DOE informed itself of and “consider[ed]” the effects of domestic greenhouse gas emissions. *Baltimore Gas & Elec. Co. v. Nat. Res. Def. Council*, 462 U.S. 87, 96 (1983). DOE argues that the information it provides is adequate because Sierra Club was able to use this information, after much effort, to provide some estimates of the impacts of induced gas production. DOE Br. at 57. But nothing in the record indicates that DOE itself undertook any comparable analysis, much less considered the combined impact on domestic emissions. Nowhere—not in the EIS, the Addendum, the Global Life Cycle Report, nor anywhere else—did DOE answer the basic question of the amount of additional greenhouse gases which could be emitted in the U.S. as a result of the individual or cumulative exports.

This impact on domestic emissions is significant, and requires attention, *in addition to* discussion of the net effects on global emissions. Comment on Global Life Cycle Report at 12-14, JA0747-0749; Rehearing Request at 14, 20-21, JA1071, 1077-1078. The U.S. has adopted numerous emission reduction targets and commitments. Opening Br. at 34-37. These commitments do not enable the U.S. to

claim that domestic emission increases are offset by displacement of other emissions abroad; that exports may frustrate these commitments is significant, and required analysis under NEPA. Comment on Global Life Cycle Report at 14, JA0749 (summarizing IPCC, Guidelines for National Greenhouse Gas Inventories, p. 8.4, JA0761).

3. Predicting the Extent of Impacts Would Not Be Exorbitantly Costly

As explained above, the record identifies numerous tools and models capable of providing information about the extent and severity of upstream impacts. DOE does not dispute the validity of these tools and has failed to show that it lacks the information necessary to use them here.

DOE argues that predicting the play-level impacts of exports would be a “heavy burden.” DOE Br. at 27, 44, 47. Like “reasonable certainty,” this is not a term with significance in the NEPA regulations or caselaw. NEPA requires DOE to provide information essential to analysis of foreseeable impacts unless DOE demonstrates that the cost



of doing so would be “exorbitant.” 40 C.F.R. § 1502.22(a);<sup>6</sup> *Neighbors of Cuddy Mountain*, 137 F.3d at 1380 (agency bears burden of showing that detailed information could not be provided).

DOE offers no facts or evidence regarding the cost, time, or other burden that would be imposed by such modeling. Other agencies have not found NEMS modeling to be exorbitantly expensive even when it is used *solely* to address environmental impacts, unlike here, where DOE already used NEMS to model economic impacts. *Mayo Found.*, 472 F.3d at 555.

Nor does DOE identify any evidence suggesting it would be exorbitantly expensive to evaluate the likely extent of impacts on regional ozone levels. As the Addendum recognizes, the Bureau of Land Management has used the “CAMx” photochemical model to forecast, for

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<sup>6</sup> Respondents argue that this regulation only applies “[w]hen an agency is evaluating reasonably foreseeable significant adverse effects on the human environment.” 40 C.F.R. § 1502.22. DOE’s brief does not dispute that the effects at issue here are reasonable foreseeable; DOE claims to have foreseen their “type and nature.” DOE Br. at 38.

purposes of NEPA review, the effect of additional gas development on regional ozone levels. Addendum at 28, JA0842.<sup>7</sup>

4. DOE's Shallow Analysis of Upstream Impact Cannot Be Upheld Under the 'Rule of Reason'

DOE argues that “even if DOE ‘could have provided a more rigorous quantitative evaluation, ... it does not follow that [DOE’s] qualitative analysis was arbitrary and capricious,’” and that NEPA’s “rule of reason” condones DOE’s decision to omit foreseeable information regarding the extent of impacts. DOE Br. at 42 (quoting *Western Watersheds Project v. Bureau of Land Mgmt.*, 721 F.3d 1264, 1277 (10th Cir. 2013)), 44 (quoting *Public Citizen*, 541 U.S. at 767). As set forth above, DOE’s so-called qualitative analysis is woefully inadequate.

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<sup>7</sup> EPA analysis for the Cross-State Air Pollution Rule demonstrated that CAMx can be used to comprehensively model regional ozone impacts throughout the nation. EPA, *Regulatory Impact Analysis for the Federal Implementation Plans*, 60-61 (June 2011), <https://www3.epa.gov/crossstaterule/pdfs/FinalRIA.pdf>.

No case has held that where an agency acknowledges that effects could be significant, DOE Br. at 31, 61, the agency may omit available, reasonably foreseeable analysis of extent and severity. Where information “relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives ... the agency *shall* include the information in the environmental impact statement” unless the costs of obtaining it are “exorbitant.” 40 C.F.R. § 1502.22(a) (emphasis added). Even where information regarding the extent of impacts cannot be obtained, the agency must attempt to evaluate those impacts with available tools. *Id.* § 1502.22(b)(4).

In light of these obligations, courts have upheld agency omission of practicable analysis only where the agency provided other analysis sufficient to determine the extent of impacts. For example, *Western Watersheds Project* concerned the Bureau of Land Management’s analysis of whether its actions would lead to livestock populations in excess of the “carrying capacity” of the federal lands at issue. 721 F.3d at 1277. The Bureau was able to definitively conclude, on the basis of a qualitative analysis, that its action would not have this effect. *Id.* Similarly, in *Coalition on Sensible Transportation v. Dole*, this Court

held that where an agency demonstrated that impacts would not be significant, NEPA did not require further detail. 826 F.2d 60, 66-67 (D.C. Cir. 1987). In *Citizens Against Burlington v. Busey*, the Federal Aviation Administration conducted an extensive quantitative analysis, using accepted scientific methods, of the noise impacts of changes at an airport. 938 F.2d 190, 200 (D.C. Cir. 1991). Because the agency had already provided a hard look at the extent of noise impacts, this Court held that the agency's decision not to provide additional analysis was consistent with the rule of reason. *Id.* at 201. Here, in contrast, DOE admits that it "did not attempt to identify or characterize the incremental environmental impacts that would result from LNG exports," Authorization Order at 84, JA1024, despite DOE's determination that these "effects could be significant," DOE Br. at 31.

Nor is this case like *Public Citizen*, which held that environmental information would not be "useful" to decisionmaking because the statute at issue did not provide discretion to consider such information. 541 U.S. at 770; *Citizens Against Rails-to-Trails v. Surface Transp. Bd.*, 267 F.3d 1144, 1151 (D.C. Cir. 2001) ("The touchstone of whether NEPA applies is discretion."). DOE has not identified a single case in which an

agency, in determining whether or not to take an action, permissibly determined that it would not be “useful” to provide otherwise absent analysis of the foreseeable extent and severity of the effects of that very action, whether the effects were direct, indirect, or cumulative.

C. Downstream Effects

All exported LNG will be transported by ocean-going tanker, regasified, and burned. Each of these “downstream” processes will emit foreseeable quantities of greenhouse gas. Global Life Cycle Report at 10, JA0595. Rather than provide an estimate of the likely aggregate amount of these emissions, DOE chose to address downstream impacts by comparing the emissions from U.S. LNG with those that would result from generating an equivalent amount of energy from other sources. *Id.* Although Sierra Club does not challenge DOE’s decision to use this method of analysis, DOE must not do so in a way that provides an incomplete and misleading picture.<sup>8</sup> *Hughes River Watershed*

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<sup>8</sup> Contrary to Freeport’s argument, Sierra Club’s rehearing request identified DOE’s flawed treatment of downstream greenhouse gas emissions as a NEPA violation. Rehearing Request at 14, JA1071.

*Conservancy v. Glickman*, 81 F.3d 437, 446 (4th Cir. 1996) (holding that EIS violated NEPA by estimating gross, rather than net, economic benefit).

DOE violated NEPA by only comparing the emissions of U.S. LNG to the emissions of coal or other sources of natural-gas, while omitting a similar comparison to renewables. Authorization Order at 90-92, JA1030-1032. DOE argues that these asymmetrical comparisons are apt because coal and gas are the “prevalent” energy sources in likely import markets. *Id.* at 93, JA1033. DOE acknowledges, however, that U.S. LNG will also compete with renewables, *id.*, and record evidence demonstrates that renewables are more prevalent than natural-gas in many likely import markets. *See, e.g.*, EIA, India Analysis Brief, JA0735.

DOE provided no analysis whatsoever of the effects of displacement of wind or solar power. DOE has never argued that it lacks the information or tools necessary to provide a comparison analogous to those DOE provided for coal or natural-gas.

DOE now argues, for the first time, that comparisons between U.S. LNG and renewables are unnecessary because “it is already known

that renewable power generation has a smaller carbon footprint than fossil-fuel power generation.” DOE Br. at 58. NEPA requires agencies to gather and disclose information; agencies cannot avoid discussion of impacts merely by asserting that those impacts are already known. The issue is not just whether renewables have lower emissions than U.S. LNG, but how much lower, and the consequences of this difference. Because emissions from renewables are *much* lower than emissions from LNG, it is likely that if even a small fraction of exported LNG displaces renewables, the net impact will be an increase in global greenhouse gas emissions. Opening Brief at 76, Comment on Global Life Cycle Report at 2-3, JA0737-0738. As Sierra Club’s comments explained, providing estimates of the life-cycle emissions of renewables would allow DOE to examine the net impact of exports in different possible scenarios and disclose, for example, the level of renewable displacement that would cause exports to increase global emissions. *Id.*

The record demonstrates that it is reasonably foreseeable that some U.S. LNG will displace renewable energy. DOE failed to provide any analysis of the consequences of this displacement, and therefore failed to provide a hard look at downstream impacts.

## II. Natural Gas Act

In determining whether exports are consistent with the public interest under the Natural Gas Act, DOE must consider environmental impacts. *Myersville Citizens for a Rural Cmty. v. FERC*, 783 F.3d 1301, 1307 (D.C. Cir. 2015). DOE acknowledges that the impacts of export-induced gas production are potentially significant, DOE Br. at 61, yet it failed to provide a rational basis for concluding that the benefits of exports outweigh the environmental harms.

DOE must provide *some* rationale in order to conclude that exports' benefits exceed their harms. The Natural Gas Act does not require a "formal cost-benefit analysis." DOE Br. at 60. Whatever method of comparison DOE chooses, however, must be rational. *High Country Conservation Advocates v. U.S. Forest Service*, 52 F. Supp. 3d 1174, 1182, 1190 (D. Colo. 2014) ("NEPA does not require an explicit cost-benefit analysis," but "where such an analysis is included it cannot be misleading."). Here, DOE stated that denying exports would forgo "entirely" the benefits *of exports* while only causing a "modest, incremental" impact on the problems *of gas production as a whole*. This is capricious reasoning: 'all of A' can easily be less than 'some of B.'



DOE's approach would conclude that exports were in the public interest even if export provided a single dollar of benefit—which would “entirely” be forgone by an export prohibition—while causing hundreds of additional premature deaths because of air pollution. *See Michigan v. EPA*, 135 S. Ct. 2699, 2707 (2015) (holding irrational an approach that might “impose billions of dollars in economic costs in return for a few dollars in health or environmental benefits.”). DOE's conclusion that environmental impacts would be “modest”<sup>9</sup> is all the more capricious because DOE admits that it “did not attempt to identify or characterize the incremental environmental impacts” of exports. Authorization Order at 84, JA1024.

DOE alternatively argues that environmental impacts are *per se* not a reason for concluding that exports are contrary to the public interest because the “public interest is better served[]’ by controlling the adverse environmental effects of natural-gas development directly, *via* federal, state, and local regulation.” DOE Br. at 61. The Natural

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<sup>9</sup> Contra DOE's assertion, Sierra Club does not agree that this characterization was “fair.” DOE Br. at 60.

Gas Act is centrally concerned with effects on gas production and supply, notwithstanding the fact that the Act does not provide authority to regulate these issues directly. *NAACP*, 425 U.S. at 669–70, 670 n.6. Section 3’s “public interest” determination encompasses environmental effects. *Id.* If DOE can decline to consider the environmental effects of increased gas production, then it is unclear when DOE would ever consider environmental effects in its public interest analysis. Nor has DOE explained why other regulators, which generally have authority over the manner in which gas production is conducted, are better situated to avoid the harms of export-induced gas production than DOE, which is deciding whether to provide an expanded market that will determine whether additional production occurs at all.

### CONCLUSION

For the reasons set forth above, Sierra Club respectfully requests that DOE’s Authorization Order and Rehearing Order be vacated and remanded.

Dated July 5, 2016.

/s/ Nathan Matthews

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**CERTIFICATE OF COMPLIANCE WITH WORD LIMITATION**

Counsel hereby certifies that, in accordance with Federal Rule of Appellate Procedure 32(a)(7)(C), the foregoing Final Reply Brief of Petitioner Sierra Club contains 6,992 words, as counted by counsel's Microsoft Word processing program.

Dated: July 5, 2016.

*/s/ Nathan Matthews*

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**CERTIFICATE OF SERVICE**

I hereby certify that on this 5<sup>th</sup> day of July, 2016, I electronically filed the foregoing with the Clerk of the Court using the CM/ECF system, which will send notice of such filing to all registered CM/ECF users.

/s/ Nathan Matthews

Nathan Matthews

**ORAL ARGUMENT NOT YET SCHEDULED**

**No. 15-1489**

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**IN THE UNITED STATES COURT OF APPEALS  
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

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SIERRA CLUB,

*Petitioner,*

v.

UNITED STATES DEPARTMENT OF ENERGY,

*Respondent,*

AMERICAN PETROLEUM INSTITUTE, LLC, ET AL.,

*Intervenors for Respondent.*

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On Petition for Review of Orders of the Department of Energy 3357-B  
(November 14, 2014) and 3357-C (December 4, 2015)

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**ADDENDUM TO THE REPLY BRIEF  
OF PETITIONER SIERRA CLUB**

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Dated: July 5, 2016.

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## United States Code Annotated

## Title 42. The Public Health and Welfare

## Chapter 55. National Environmental Policy (Refs &amp; Annos)

## Subchapter I. Policies and Goals (Refs &amp; Annos)

## 42 U.S.C.A. § 4331

## § 4331. Congressional declaration of national environmental policy

## Currentness

(a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this chapter, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may--

- (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- (2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
- (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
- (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
- (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
- (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

A-001



**CREDIT(S)**

(Pub.L. 91-190, Title I, § 101, Jan. 1, 1970, 83 Stat. 852.)

**EXECUTIVE ORDERS**

**EXECUTIVE ORDER NO. 11507**

[Ex. Ord. No. 11507](#), eff. Feb. 4, 1970, 35 F.R. 2573, which related to prevention, control, and abatement of air and water pollution at federal facilities was superseded by [Ex. Ord. No. 11752](#), eff. Dec. 17, 1973, 38 F.R. 34793, formerly set out as a note under this section.

**EXECUTIVE ORDER NO. 11752**

[Ex. Ord. No. 11752](#), Dec. 17, 1973, 38 F.R. 34793, set out as a note under this section, which related to the prevention, control, and abatement of environmental pollution at Federal facilities, was revoked by [Ex. Ord. No. 12088](#), Oct. 13, 1978, 43 F.R. 47707, set out as a note under [section 4321](#) of this title.

[Notes of Decisions \(42\)](#)

42 U.S.C.A. § 4331, 42 USCA § 4331

Current through P.L. 113-296 approved 12-19-2014

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Regulatory Impact Analysis (RIA)  
for the final Transport Rule  
Docket ID No. EPA-HQ-OAR-2009-0491

Regulatory Impact Analysis for the Federal Implementation Plans to  
Reduce Interstate Transport of Fine Particulate Matter and Ozone in 27  
States; Correction of SIP Approvals for 22 States

U.S. EPA  
Office of Air and Radiation

June 2011

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## CHAPTER 4

### AIR QUALITY MODELING AND IMPACTS

#### 4.1 Air Quality Impacts

This section summarizes the methods for and results of estimating air quality for the 2014 base case and control scenario for the purposes of the benefit analysis. EPA has focused on the health, welfare, and ecological effects that have been linked to air quality changes. These air quality changes include the following:

1. Ambient fine particulate matter (PM<sub>2.5</sub>) and ground-level ozone (O<sub>3</sub>)—as estimated using a national-scale applications of the Comprehensive Air Quality Model with Extensions (CAMx; Environ, 2010);
2. Visibility degradation (i.e., regional haze), as developed using empirical estimates of light extinction coefficients and efficiencies in combination with CAMx modeled reductions in pollutant concentrations.

The air quality estimates in this section are based on the emission changes summarized in the preceding section. These air quality results are in turn associated with human populations and ecosystems to estimate changes in health and welfare effects. In Section 4.1.1, we describe the air quality modeling platform and in Section 4.2, we cover the impacts on PM<sub>2.5</sub> and ozone. Lastly, in Section 4.3, we discuss the estimation of visibility degradation.

##### *4.1.1 Air Quality Modeling Platform*

We use the emissions inputs summarized above with national scale and regional scale application of the CAMx modeling system to estimate PM<sub>2.5</sub> and ozone air quality in the contiguous U.S. CAMx is a three-dimensional grid-based Eulerian photochemical model



designed to estimate PM<sub>2.5</sub> and ozone concentrations over annual time periods. Consideration of the different processes that affect primary (directly emitted) and secondary (formed by atmospheric processes) PM<sub>2.5</sub> in different locations is fundamental to understanding and assessing the effects of pollution control measures that affect PM<sub>2.5</sub> and ozone concentrations at the surface.<sup>15</sup> Because it accounts for spatial and temporal variations as well as differences in the reactivity of emissions, CAMx is useful for evaluating the impacts of the rule on PM<sub>2.5</sub> and ozone concentrations. Version 5.3 of CAMx was employed for this Transport Rule modeling, as described in the Air Quality Modeling Technical Support Document (EPA, 2011).

For this analysis we used CAMx to simulate air quality for every hour of every day of the year. These model applications required a variety of input files that contain information pertaining to the modeling domain and simulation period. In addition to the CAMx model, our modeling system includes (1) emissions for a 2005 base year and emissions for the 2014 base case and control scenario, (2) meteorology for the year 2005, and (3) estimates of intercontinental transport (i.e., boundary concentrations) from a global photochemical model. Using these data, CAMx generates hourly predictions of ozone and PM<sub>2.5</sub> component species concentrations. As discussed in the Air Quality Modeling TSD, we use the relative predictions from the model by combining the 2005 base-year and each future-year scenario with speciated ambient air quality observations to determine the expected change in 2014 concentrations due to the rule. After completing this process, we then calculated annual mean PM<sub>2.5</sub> and seasonal mean ozone air quality metrics as inputs to the health and welfare C-R functions of the benefits analysis.

#### *4.1.1.1 Simulation Periods*

For use in this benefits analysis, the simulation period modeled by CAMx included separate full-year application for each of the three emissions scenarios (i.e., 2005 base year and the 2014 base case and 2014 control scenario).

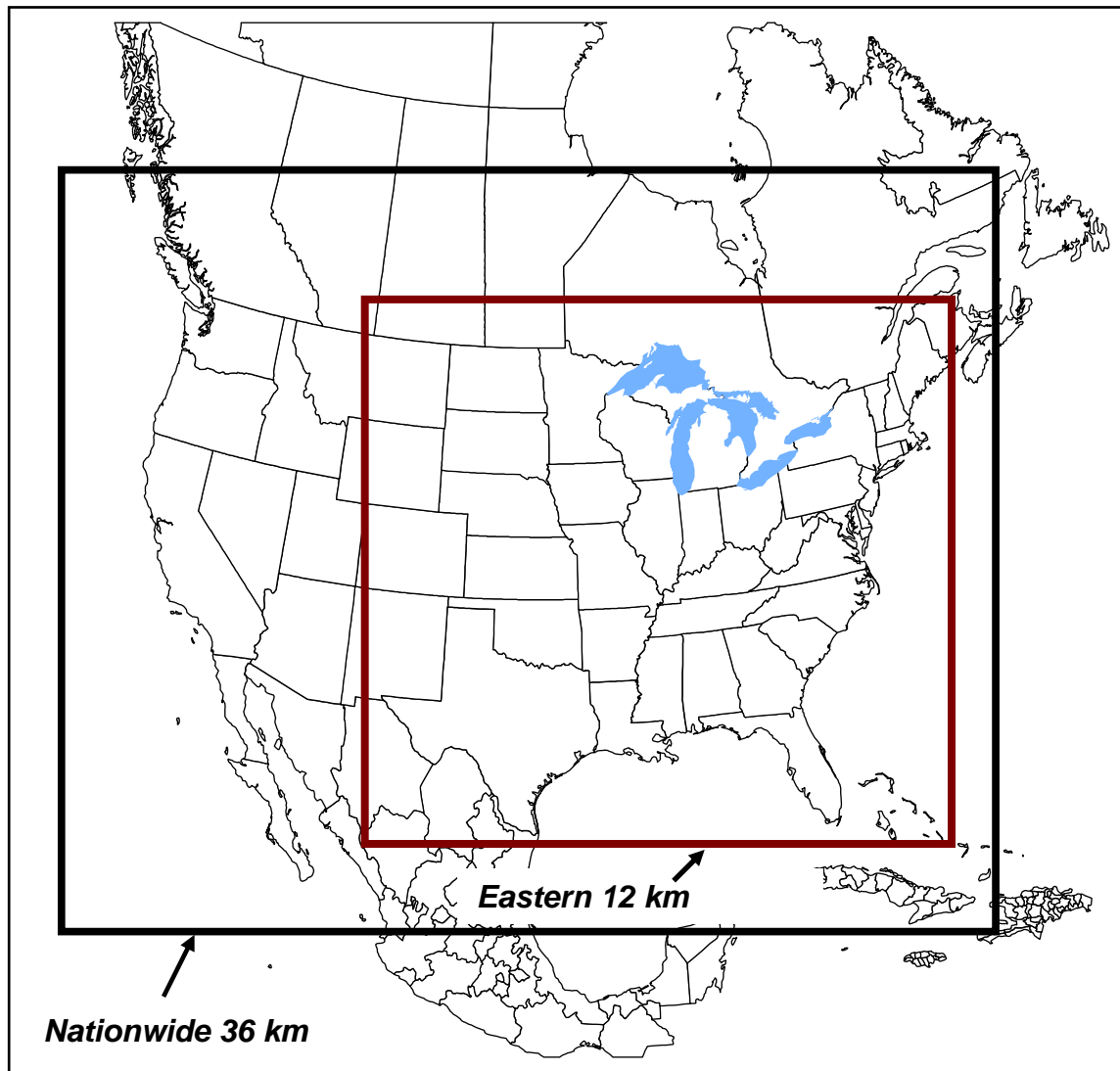
#### *4.1.1.2 Air Quality Modeling Domain*

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<sup>15</sup>Given the focus of this rule on secondarily formed particles it is important to employ a Eulerian model such as CAMx. The impact of secondarily formed pollutants typically involves primary precursor emissions from a multitude of widely dispersed sources, and chemical and physical processes of pollutants are best addressed using an air quality model that employs an Eulerian grid model design.

Although air quality estimates are provided for the entire U.S., the focus of our analysis is on the Eastern U.S. since this is the geographic area of importance for this rule. The areas modeled (i.e., modeling domains) are segmented into rectangular blocks referred to as grid cells. The model actually predicts pollutant concentrations for each of these grid cells. Our modeling for the East (referred to as the Eastern regional scale domain) was performed at a horizontal resolution of 12 x 12 km. Modeling for the remainder of the U.S. (referred to as the national scale domain) was performed at a resolution of 36 x 36 km. The national and regional scale modeling domains contain 14 vertical layers with the top of the modeling domain at about 16,200 meters, or approximately 100 mb. The Eastern domain is nested within the National domain, as shown in Figure 4-1.

**Figure 4-1. National and Eastern U.S. air quality modeling domains.**



**CERTIFICATE OF SERVICE**

I hereby certify that on this 5<sup>th</sup> day of July, 2016, I electronically filed the foregoing with the Clerk of the Court using the CM/ECF system, which will send notice of such filing to all registered CM/ECF users. Hard copies will be served to those not registered for CM/ECF.

/s/ Nathan Matthews

Nathan Matthews